3-D Numerical Realization of Contituent-Level FRP Composites Using X-Ray Computer Tomography

Completed Technology Project (2013 - 2014)

Project Introduction

Develop met . hods coupling state-of-the-art, nondestructive characterization techniques with three-dimensional, numerical modeling to study the constituent-level failure of fiber-reinforced polymer (FRP) composites

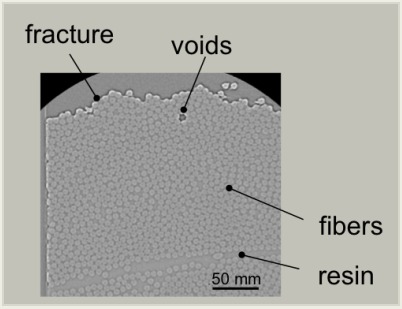
The objective of the project is to initiate realization of the Digital Twin concept for composites by coupling state-of-the-art, nondestructive characterization techniques with 3D numerical modeling to study the constituent-level failure of FRP composites. Near-term implications for this work include significantly increasing our understanding of the fundamental, constituent-level, failure mechanisms in current FRP composites through ultra-realistic, multi-physics simulations. The work will have long-term impacts on the design of innovative composites by virtual testing and on the incorporation of composites into the Digital Twin framework. The initial benchmark for success will be the high resolution (i.e. 385 nm) characterization, reconstruction, and finite element discretization of an approximately 130×130×130 mm3 volume of unidirectional graphite/epoxy composite (e.g. IM7/8552, AS4/3501-6).

Anticipated Benefits

This activity will continue under the Tier-2 IRAD project entitled "3D Numerical Realization of FRP Microstructure From High-Resolution X-ray Computed Tomography."

This work will significantly increasing our understanding of the fundamental, constituent-level, failure mechanisms in current FRP composites through ultra-realistic, multi-physics simulations.

This work will have a long-term impacts on the design of innovative composites by virtual testing and on the incorporation of composites into the Digital Twin framework.



Project Image 3-D Numerical Realization of Contituent-Level Frp Composites Using X-Ray Computer Tomography

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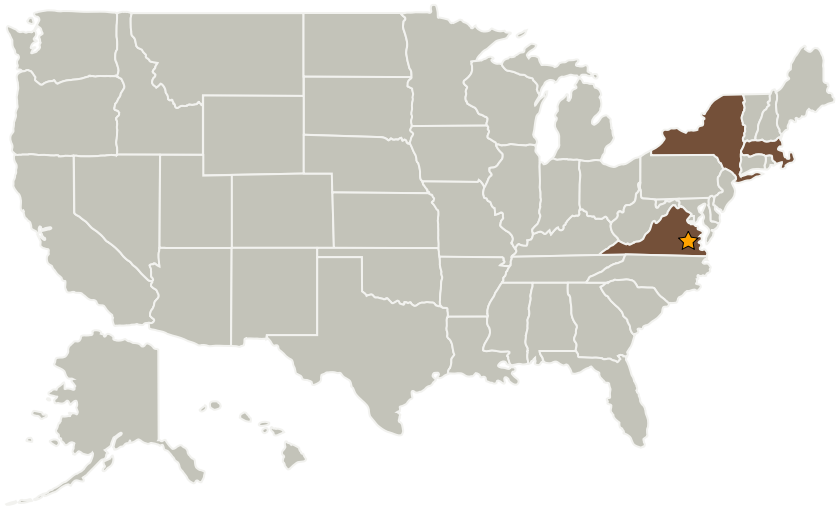
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
Cornell University	Supporting Organization	Academia	Ithaca, New York
The Charles Stark Draper Laboratory, Inc.	Supporting Organization	R&D Center	Cambridge, Massachusetts

Primary U.S. Work Locations	
Massachusetts	New York
Virginia	

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Independent Research & Development: LaRC IRAD

Project Management

Program Manager:

Julie A Williams-byrd

Project Manager:

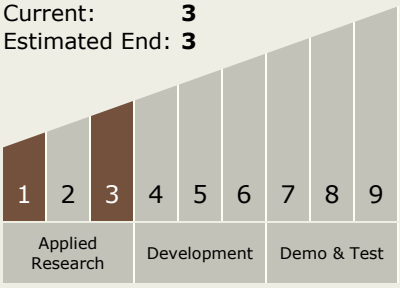
Michael W Czabaj

Principal Investigator:

Michael W Czabaj

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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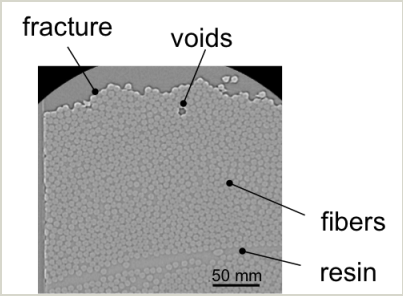
Images



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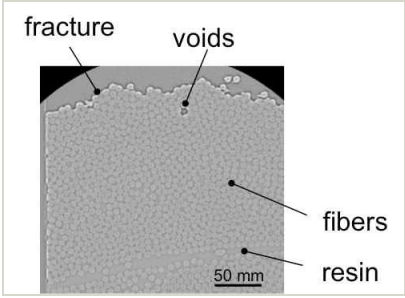
Project Image 3-D Numerical Realization of Contituent-Level Frp Composites Using X-Ray Computer Tomography
(https://techport.nasa.gov/image/2283)



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Project Image 3-D Numerical Realization of Contituent-Level Frp Composites Using X-Ray Computer Tomography
(https://techport.nasa.gov/image/2284)

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL